

GTI Field Applied Coatings Research Program

Presented to OPS Advanced Pipeline Coatings Workshop

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Paul Beckendorf
Gas Technology Institute

Pipeline Integrity and Coatings

- > Maintaining pipeline integrity: Critical for continued safe operation of gas distribution and transmission systems
- > Accomplished through a comprehensive corrosion control program which includes correctly specified and applied coatings used in conjunction with cathodic protection
- > Large selection of coating systems on the market
 - Endless new product introductions
 - Many product reformulations
 - > Improvements
 - > Changes to meet new regulations
 - The multiple choices present a challenge for Corrosion Engineer and Integrity Managers

GTI's Project

- > To thoroughly test the full range of available coating systems
 - Determine which coating systems are most suitable for various environments and situations
 - Provide pipeline operators with information needed to make critical decisions regarding coating systems
- > Project results to date will be issued in 3Q05
 - Gas Transmission Company funders - comprehensive results
 - Manufacturers
 - > Overall generic results
 - > Product-specific results to each manufacturer for their products only

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Pipeline Coatings Evaluations Underway at GTI

- > In 2002 – FBE Compatible Test – Over 700 applications of 70+ pipeline coating systems made to 24" & 8" welded pipe sections
 - The pipe sections, except for the weld joints, coated with FBE
 - Weld joints coated with the full range of available coating systems
 - Manufacturers applied their respective coatings
 - Samples excavated and analyzed in 2004 and early 2005
 - All work performed per agreed-to specifications (handouts)

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Pipeline Coatings Evaluations Underway at GTI

- > In 2004 – 3-Layer PE Compatible Test - Over 300 applications of 30+ pipeline coating systems made to 8” welded pipe sections
 - Pipe sections, except for the weld joints, coated with 3-layer PE
 - Weld joints coated with full range of available coating systems that are compatible with 3-layer PE
 - Manufacturers applied their respective coatings
 - All work performed per agreed-upon specifications

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Pipeline Coatings Evaluations Underway at GTI

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Phase One – FBE Parent Pipe

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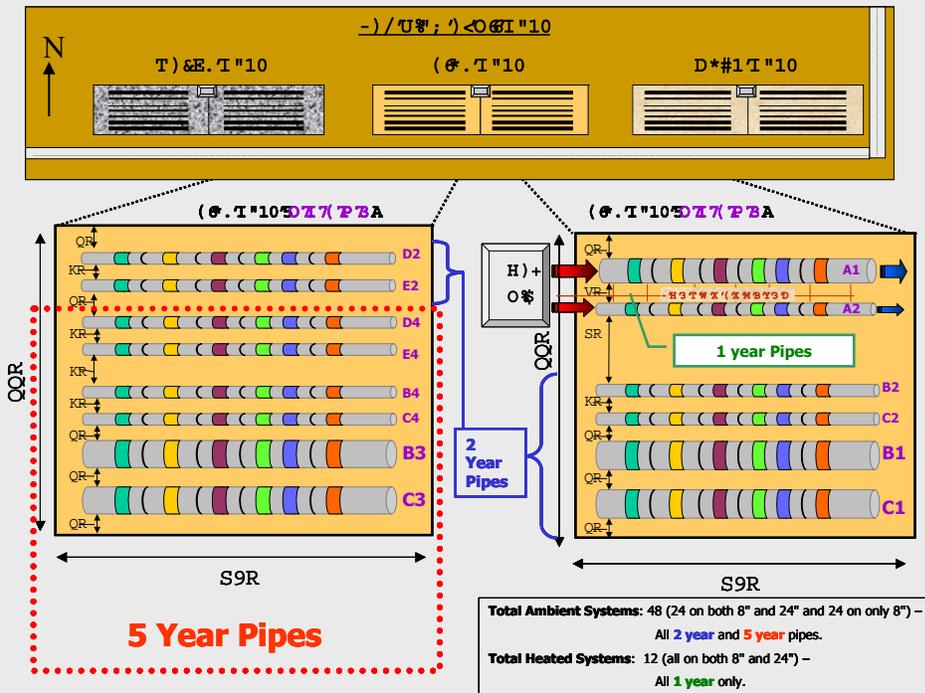
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GTI Soil Bed Construction



Geotextile & Geomembrane Installation – Moisture & Washout Control



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Installation of Drainage System



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Pipeline Coatings Evaluation Cutback Mark Off



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Pre-grooving and Welding of Cut Back Areas



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Test Joints As Welded and Feathered



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Surface Preparation of Pipes



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Fusion Bonded Epoxy Field Applications



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Liquid Applications – Brush, Sponge, and Roller



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Liquid Applications – Poured into Casting



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Flame Spray and Shrink Sleeve Applications



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Polymer Concrete and Tape Applications



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Airless and Plural Component Applications



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FBE Coated Pipes Covered in Tyvek and Awaiting Final Holiday Testing



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Controlled Placement of Coated Pipe in Test Facility



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Triangulation, Sensor Placement, and CP Hook Up



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Backfill Operation



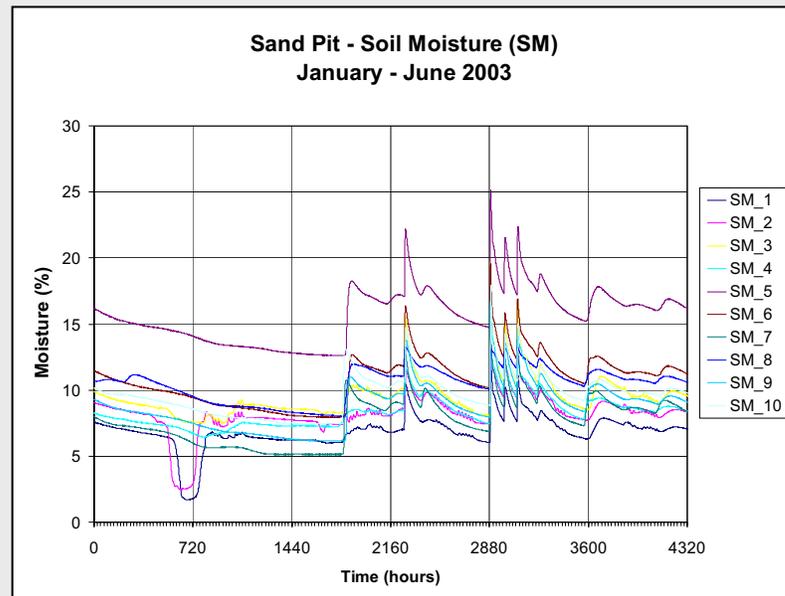
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Internal Pipe Heating System



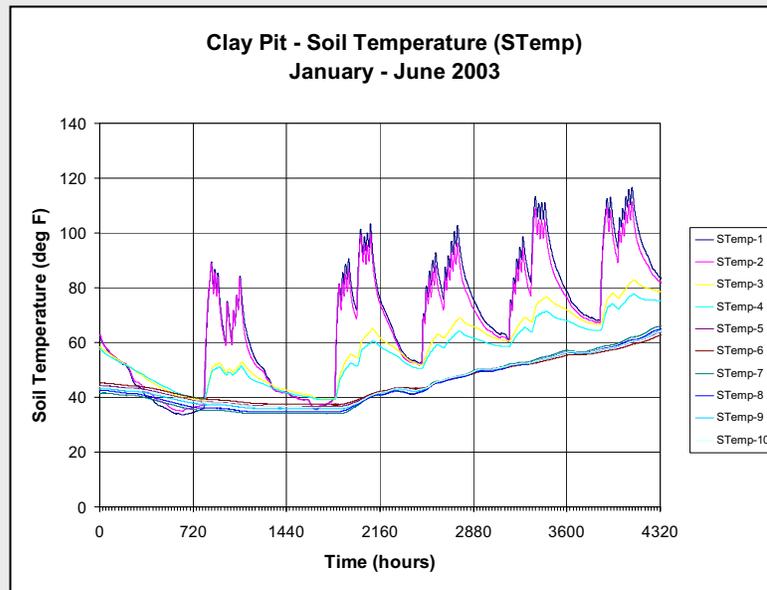
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Field Applied Coatings Research – Soil Moisture Data



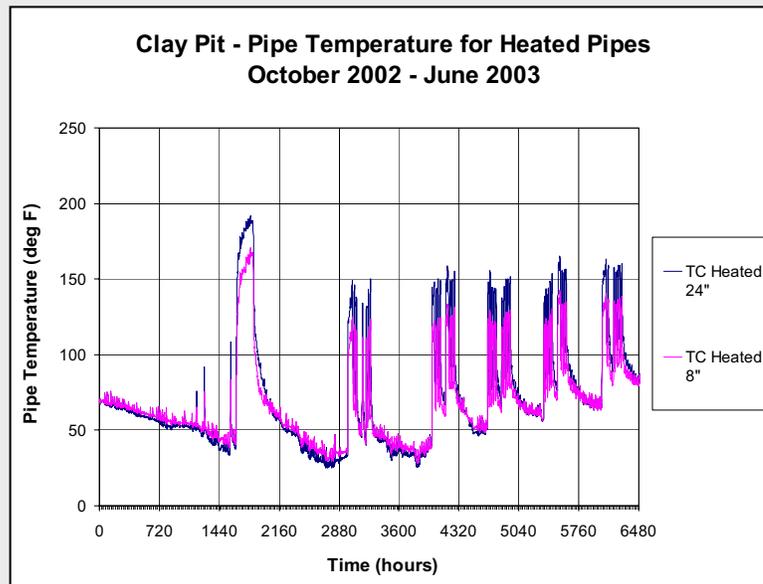
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Field Applied Coatings Research – Soil Temperature Data



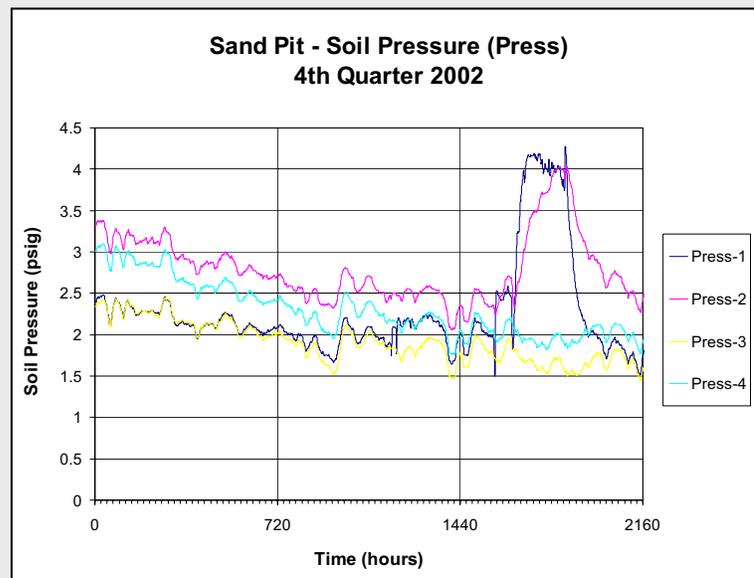
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Field Applied Coatings Research – Pipe Surface Temperature Data



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Field Applied Coatings Research



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Pipeline Coatings Quantitative Testing – Control and Field Samples

- > Impact Resistance (ASTM G-14).
- > Adhesion (ASTM D-4541).
- > Hardness (ASTM D-2240, 2583).
- > Penetration Resistance (ASTM G-17).
- > Abrasion Resistance (Tabor)
- > Cathodic Disbondment (ASTM G-8, 42, 95).

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Visual Inspection of Excavated Coating Systems



- > Indentions
- > Abrasions
- > Deformations
- > Rust
- > Blistering
- > Wrinkles
- > Peeling
- > Delamination

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Post-Excavation Hardness and Holiday Testing

- > All joints tested for pinholes and cracks
- > Hardness testing measurements taken to compare to original hardness



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Adhesion Testing



- > Adhesive and cohesive failures
- > Adhesion strength measured up to 3,000 psi

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Peel Testing

- > Some field-joint systems, such as the heat shrink sleeves, tapes, wraps and composites were not suitable for adhesion testing due to their composition
- > For these systems, a specially modified GTI peel test protocol was established and used.



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Failure Analysis



- > In some cases, the failure investigation revealed serious deficiencies in the coating system that resulted in severe rusting and pitting on the substrate, under the coating
- > During failure investigation, the condition of the underlying substrate was documented and photographed for future reference and evaluation

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Next Steps

- > 3Q05 – Issue Report of Findings to Date
- > 2007 – Excavate 5 year FBE Compatible Coating Systems for Failure Analysis and Testing
- > 2007-2008 – Excavate 3 year 3-Layer PE Compatible Coating Systems for Failure Analysis and Testing

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Questions ???

For further, detailed information, contact

Daniel Ersoy
GTI
R&D Manager
847.768.0663
daniel.ersoy@gastechnology.org

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Paul Beckendorf
GTI
847.768.0889
paul.beckendorf@gastechnology.org